Comparison of sugarcane STICS model calibrations to simulate growth response to climate variability

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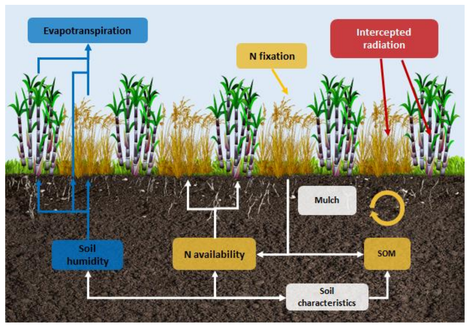
The STICS model

- Simulates the carbon (C), water and nitrogen (N) balances of the soil-crop system at a daily time-step (Brisson et al., 2003).
- Description of the physical and biological processes occurring in the soil-crop system mostly relies on a unique set of general parameters for all plant crop.



Brisson N, Gary C, Justes E, et al. 2003. An overview of the crop model STICS. *European Journal of agronomy*, 18: 309-332.

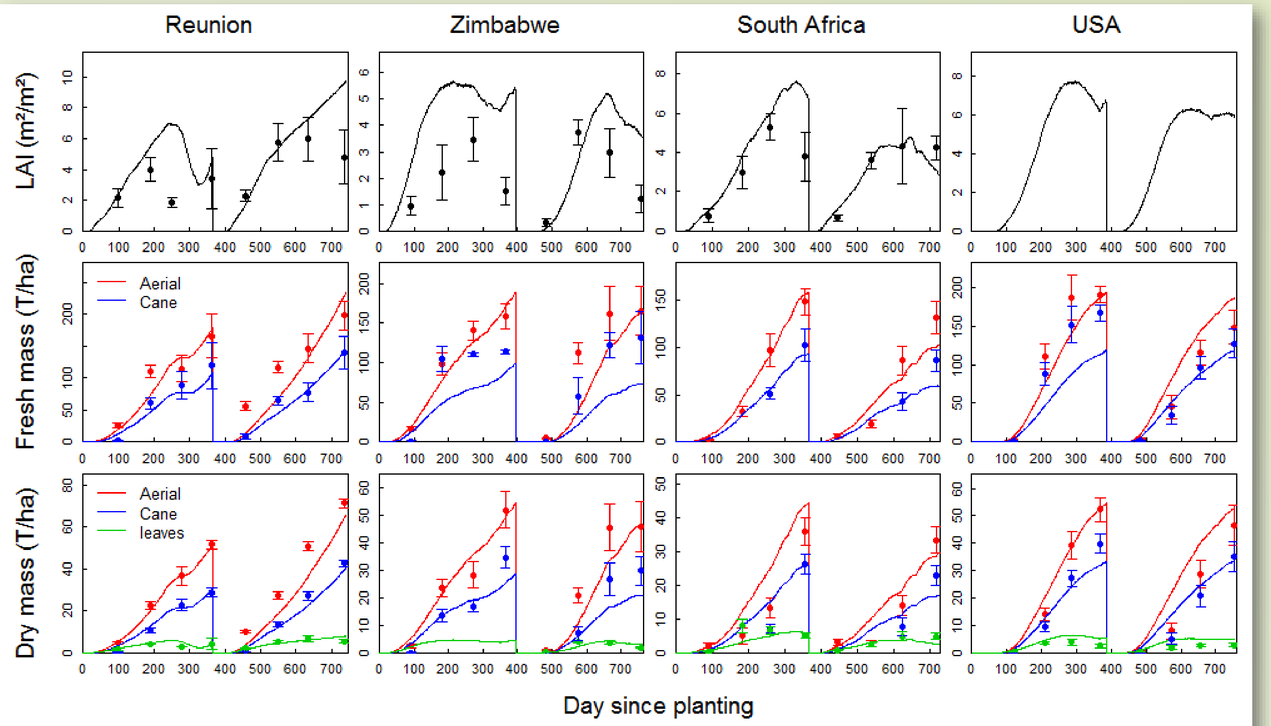


Fig. 1. Example of calibration performed on the ICSM dataset in four countries, using the Sugarcane_Stalk plant calibration. Leaf area index (LAI) and fresh and dry mass are presented during two crop cycles in 4 different countries.

Parameterization strategy

1) Measurements (e.g. SLA, N dilution curve);
2) Literature (e.g. root profile, base temperature);
3) Calibration on LAI and aboveground compartments (OptimiSTICS and Rgenoud).

→ three different calibrations of the sugarcane crop growth, each of which can be applied to different objectives:

- Cane stalks conceptualized as a grain, in order to simulate **sugar yield** (STICS v9): "Sugarcane_grain"
- Cane stalks conceptualized as a stem, in order to simulate **fresh cane yield** variability (STICS v9): "Sugarcane_stem"
- Cane with perennial reserves, in order to simulate **N translocation** and perennial reserve (STICS vX): "Sugarcane_regrowth"

Dataset

Calibration: ICSM project: similar trials in **4 countries** using the same variety and management over two crop cycle (R570, Fig. 1, Jones et al., 2020)

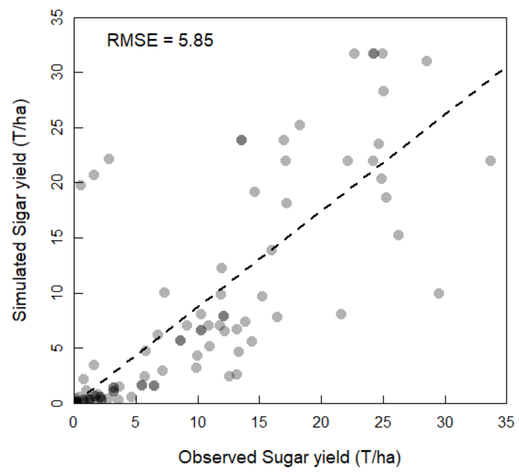
Validation: ECOFI database (Christina et al., in press), including **95 trials** with the R570 variety performed in Reunion Island and Guadeloup.

→ variables used: LAI (rmse = 1.7 – 2.0 m²/m²), Fapar (rmse = 0.25 – 0.26), aboveground, cane, leaves dry and fresh mass, sugar yield and soil water content (rmse = 0.09 – 0.11 m³/m³)

Christina M, Chaput M, Martiné JF, Auzoux S (2019). ECOFI: a database of sugar and energy cane field trials. Open Data Journal for Agricultural Research, in press.
Jones MR, Singels A, Chinorumba A, Patton C, Poser C, Singh M, Martiné JF, Christina M, Shine J, Annandale J, Hammer G (2019). Exploring process-level genotypic and environmental effects on sugarcane yield using an international experimental dataset. Field Crop Research, 244:107622.

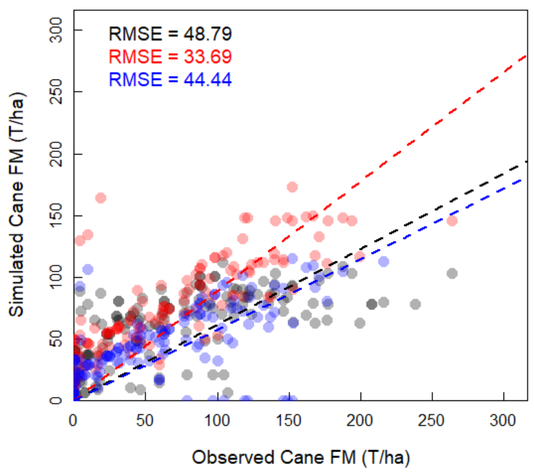
Sugarcane_grain

Objectives: sugar yield



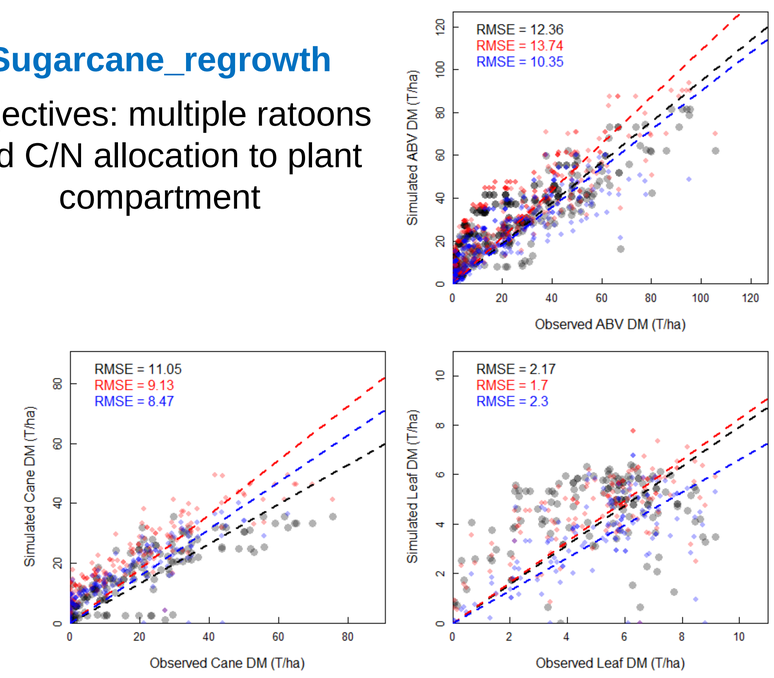
Sugarcane_stem

Objectives: cane yield



Sugarcane_regrowth

Objectives: multiple ratoons and C/N allocation to plant compartment



Perspectives

Modeling the nitrogen efficiency of sugarcane agroecosystems. Application to the integrated management of organic waste products on a territory of Reunion Island.

PhD thesis: Maxime Chaput (2018-2021)
UR AIDA / UR Recyclage & Risques

Objectives:

To develop a modeling tool, from plot to landscape scale, of the nitrogen fluxes to assess the agronomic and environmental impacts in sugarcane fields of territorial management strategies of organic waste products in Reunion Island.

Analysis and optimization of resources use efficiency (water, nitrogen, light) in multi-specific agrosystems sugarcane/legumes

PhD thesis: Pauline Viaud (2019-2022)
UR AIDA / UR Recyclage & Risques

Objectives:

- To assess the nitrogen intakes by legumes in association with sugarcane.
- To parametrized a multi-species crop model to assess the agronomic and environmental impact of legumes introduction in sugarcane system.

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